CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
SAN FRANCISCO BAY REGION

RESOLUTION NO. 94-102

POLICY ON THE USE OF CONSTRUCTED WETLANDS
FOR URBAN RUNOFF POLLUTION CONTROL

I. WHEREAS, urban runoff contributes a significant amount of pollutants to the San Francisco Bay and its tributaries; and

II. WHEREAS, the San Francisco Bay Regional Water Quality Control Board regulates urban runoff through NPDES permits and urban runoff management programs under the 1987 Clean Water Act and the Porter-Cologne Water Quality Control Act; and

III. WHEREAS, the 1990 Coastal Zone Act Reauthorization Amendments require states to implement nonpoint source management measures to protect and restore wetlands, and promote the use of vegetated treatment systems such as constructed wetlands; and

IV. WHEREAS, the state-wide nonpoint source management plan is currently under revision and this revision, in part, is intended to address measures required by the 1990 Coastal Zone Act Reauthorization Amendments; and

V. WHEREAS, proposals have been made, and demonstration projects established, to develop constructed wetland systems in order to store and treat urban runoff in the San Francisco Bay Area; and

VI. WHEREAS, the Regional Board prepared an initial study and environmental checklist evaluating significant environmental impacts in compliance with Division 13 of the Public Resource Code - California Environmental Quality Act (CEQA) - and found that no significant adverse environmental impacts would result from implementation of the policy, and subsequently prepared a negative declaration; and

VII. WHEREAS, the Regional Board concludes that this policy involves "no potential for adverse effect, either individually or cumulatively on wildlife", and is therefore exempt from Department of Fish and Game CEQA filing fees; and

VIII. WHEREAS, on August 17, 1994 this Board held a public hearing and heard and considered all comments pertaining to this matter; and

IX. WHEREAS, upon consideration of the initial study, environmental checklist and comments received, the Regional Board finds that there is no substantial evidence that the project will have a significant effect on the environment.

X. THEREFORE, BE IT RESOLVED that:

1. This Regional Board approves the CEQA negative declaration.

2. This Regional Board adopts the policy set forth in the attached document entitled "Policy on the Use of Constructed Wetlands for Urban Runoff Pollution Control."

XI. BE IT FURTHER RESOLVED that the Regional Board directs the Executive Officer to continue to work with the appropriate federal and state agencies regarding the use and maintenance of constructed wetland systems for urban runoff pollution control.

XII. BE IT EVEN FURTHER RESOLVED that:

1. The State Water Resources Control Board (State Board) is requested to approve the policy in accordance with Section 13245.5 of the California Water Code.

2. Upon approval, the State Board is requested to transmit the policy to the Office of Administrative Law for approval.

3. The Regional Board directs the Executive Officer to sign and file a Certificate of Fee Exemption with the Department of Fish and Game for this policy.

I, Steven R. Ritchie, Executive Officer, do hereby certify the foregoing is a full, true, and correct copy of a Resolution adopted by the California Regional Water Quality Control Board, San Francisco Bay Region, on August 17, 1994.

Steven R. Ritchie
Executive Officer

POLICY ON THE USE OF CONSTRUCTED WETLANDS FOR URBAN RUNOFF POLLUTION CONTROL

Background

Urban runoff consists of storm water and other discharges from urban sources, and is a significant contributor of pollutants to the San Francisco Bay and its tributaries. The 1987 amendments to the Clean Water Act created a regulatory framework for storm water discharges in Section 402(p) under the National Pollutant Discharge Elimination System (NPDES). NPDES permits are required for storm water discharges from municipalities with populations over 100,000, designated industrial activities, construction activities that disturb greater than five acres of land, and storm water discharges that contribute to a violation of water quality standards or are significant contributors of pollutants to receiving waters.

State urban runoff pollution control measures include NPDES permits for storm water discharges from municipalities and storm water discharges associated with industrial or construction activities. The urban runoff pollution control strategy of the Regional Water Quality Control Board is contained in the Urban Runoff Management section of the Water Quality Control Plan for the San Francisco Bay Basin (September, 1992), hereafter called the Basin Plan. This strategy addresses control of pollution in urban runoff from municipalities, highways, industrial operations, and construction activities through issuance of NPDES permits, surveillance, and oversight of local agency urban runoff pollution control programs.

One potential alternative for the management of urban runoff is the constructed wetland treatment system. Wetlands generally occupy low-lying areas and, due to geographic location, receive surface runoff from adjacent lands. Studies have shown that wetlands have water quality treatment properties including pollutant removal through purification and filtering. Constructed wetland treatment systems may be feasible to control urban runoff pollution in cases of new construction and development, and retrofits of old structural controls. Constructed wetland treatment systems may also be added to existing flood control systems for purposes of water quality benefits as well as flood control enhancement.

The 1990 Coastal Zone Act Reauthorization Amendments (CZARA) require implementation of management measures to protect coastal zones from nonpoint source pollution from various sources, including urban runoff. These management measures apply to urban runoff discharges not regulated by NPDES permits, and require states to protect or restore wetlands and to promote the use of vegetated treatment systems. Vegetated treatment systems include vegetated filter strips and constructed wetlands.

Under section 6217(g) of CZARA, states are required to develop programs that ensure implementation of the management measures. Current revision of the state-wide nonpoint source management plan is intended to address CZARA requirements. This Resolution, in part, is intended to foster the use of constructed wetland systems as vegetated treatment

systems in the San Francisco Bay Area for the control of urban runoff discharges covered under CZARA.

Existing wetlands which are waters of the United States, as defined in 40 CFR Part 122.2, or waters of the state, as defined in the Water Code Section 13050 (e), are not covered under this policy. Existing wetlands of the San Francisco Bay are valuable resources that have been seriously depleted in the past. Although existing wetlands receive and likely treat urban runoff, intentional routing of untreated runoff to these wetlands may have negative impacts on wetland habitat value and water quality, and is not legally permissible unless all applicable water quality objectives for such wetlands are met. Damage to existing wetlands would constitute a net loss to the Bay system and a violation of the Clean Water Act and the Porter-Cologne Water Quality Control Act. For these reasons only the use of constructed wetlands, rather than existing or natural wetlands, will be considered under this policy for the treatment of urban runoff.

The Regional Board recognizes that in some cases it may be appropriate to route untreated urban runoff to natural or existing wetlands provided that applicable water quality objectives are met. Existing wetlands, however, are typically waters of the United States, and as such do not fall under the terms of this policy. Future regional wetlands planning efforts may establish policy or procedures regarding urban runoff and existing wetlands. For the interim, projects initiated outside the realm of this Regional Board policy will be considered on a case-by-case basis.

Preamble

The provisions which follow are intended to provide Regional Board policy on the establishment of constructed wetlands to control urban runoff pollution. Inherent in this policy is the recognition that the majority of research to date concerning wetland treatment systems pertains to treatment of wastewater. There is limited evidence on the effects, both short-term and long-term, of using wetlands for urban runoff pollution control. For this reason, a conservative approach regarding these treatment systems is warranted. Under no circumstances should wetlands constructed for purposes of urban runoff treatment preclude upstream pollution prevention measures. In the future, this policy may be modified to be consistent with ongoing regional wetlands planning efforts or revised to incorporate new evidence on the effects of using constructed wetlands for urban runoff pollution control.

For the purposes of this policy, urban runoff treatment is defined as:

> control of urban runoff pollution through the physical, chemical, or biological removal of pollutants in order to meet the requirements of the Clean Water Act imposed by NPDES permits, urban runoff management programs, or other regional or local jurisdictions.

Wetlands are defined in 40 CFR Part 122.2 as:

> *those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions.* Wetlands include saltwater marshes, freshwater marshes, open or closed brackish water marshes, swamps, mudflats, and riparian areas.

Constructed wetlands are defined according to CZARA guidelines as:

> *engineered systems designed to simulate natural wetlands to exploit the water purification functional value for human use and benefits. Constructed wetlands consist of former upland environments that have been modified to create poorly drained soils and wetlands flora and fauna for the primary purpose of contaminant or pollutant removal from wastewaters or runoff. Constructed wetlands are essentially wastewater treatment systems and are designed and operated as such though many systems do support other functional values.*[1]

POLICY

The following provisions will be followed by the Regional Board in determining whether or not to approve projects involving the use of constructed wetlands to treat urban runoff. Pursuant to 40 CFR Part 122.2, wetlands constructed and operated under this policy are waste treatment systems and, as such, are not waters of the United States.

1. The Regional Board will consider the use of wetlands for urban runoff treatment in cases where the wetlands are constructed or "artificial" systems. The use or modification of existing wetlands for urban runoff pollution control is beyond the scope of this policy. Constructed wetland systems which subsequently are connected with - or discharge to - existing wetlands may be considered provided that 1) the discharge does not violate water quality objectives, and 2) the beneficial uses of the existing wetlands are maintained or enhanced.

   Rationale: Existing wetlands are waters of the United States and are afforded protection from degradation by nonpoint source pollutants under the Clean Water Act. Direct discharges of untreated urban runoff to existing wetlands may disrupt the habitat of valuable or rare or endangered species, or may adversely alter the distribution of vegetation. Damage to existing wetlands would constitute a net loss of

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[1]D.A. Hammer, Designing Constructed Wetlands Systems to Treat Agricultural Nonpoint Source Pollution, *Ecological Engineering*, 1(1992): 49-82.

wetlands in the Bay system and a violation of the Clean Water Act, the Porter-Cologne Water Quality Control Act, and the no net loss policy. As a result, use of existing wetlands for urban runoff pollution control is beyond the scope of this policy.

The Regional Board will consider the connection of constructed wetlands to existing wetlands so long as the constructed wetlands are maintained and operated to avoid discharges of pollutants to the existing wetlands that would otherwise negatively impact or degrade the existing wetlands. In these cases, the constructed wetlands may serve as buffers and/or water sources for the existing wetlands.

2. Wetlands constructed under this policy will function as urban runoff treatment systems in order to satisfy storm water and nonpoint source discharge requirements of the Clean Water Act and the Basin Plan. Wetland systems constructed to treat urban runoff are intended, in part, to meet the Clean Water Act requirement to reduce pollutants in urban runoff discharges to the maximum extent practicable. In addition, these treatment systems are intended, in part, to prevent or eliminate violations of applicable water quality objectives, or negative impacts to beneficial uses, of receiving waters.

Rationale: The primary goal of the construction of these wetland systems is urban runoff treatment. Any other functions and values created during construction or thereafter are ancillary to the constructed wetland's purpose. As treatment systems, constructed wetlands operated and maintained according to this policy will not be waters of the United States. Constructed wetlands that are not operated and maintained according to terms of this policy and the approved management plan (required by Provision 7) may forfeit the designation of "treatment system."

Urban runoff treatment systems are intended to remove pollutants and should not contribute to or intensify water quality problems in receiving waters, including groundwater. This would *contradict* the purpose of the constructed wetland treatment system. In such cases, the treatment wetland could be subject to clean-up or discharge requirements.

3. Wetlands constructed for urban runoff treatment under this policy shall be constructed separate from the receiving water. Instream systems are constructed within waters of the United States, subject to Clean Water Act Section 401 and 404 requirements, and do not fall under the terms of this policy. Any wetland system constructed instream will be a water of the United States and subject to all applicable Clean Water Act and Basin Plan regulatory and water quality requirements.

Rationale: Instream systems are constructed within existing waters of the United States (e.g., wetlands, streams and creeks). As a result, any wetland constructed in a water of the United States would be a water of the United States by default, regardless of treatment functions. Therefore, instream systems do not fall under the terms of this policy and will require satisfaction of all applicable regulatory requirements, including Clean Water Act Section 404 permits and Section 401 water quality certification.

4. The Regional Board will require the proponent to demonstrate (1) a commitment of an adequate amount of land to maintain urban runoff treatment functions in the constructed wetland; and (2) a commitment to manage the constructed wetland to maintain urban runoff treatment functions.

Rationale: The intent of this provision is to assure that adequate land and management resources are available for as long as the constructed wetland is intended for urban runoff treatment. The commitment to provide the land and management resources may come from a person or persons other than the proponent, such as local agencies. However, the commitment must be such that the land or management resources cannot be withdrawn without Regional Board notification. In addition, there must be sufficient advance notice to provide for acceptable alternative disposal or reclamation facilities for the runoff - or explanation of the reason the constructed wetland is no longer necessary.

5. Prior to authorizing the construction of a urban runoff treatment wetland, the Regional Board will require demonstration that the wetland will be managed so as not to create vector problems and nuisance, and so as to minimize the occurrence of avian botulism and other infectious diseases. The Regional Board will also require reasonable monitoring to demonstrate that, consistent with a treatment system, pollutants and other substances transferred to the constructed wetland do not harm wildlife due to direct toxicity or bioaccumulation in the food chain.

Rationale: Control of vectors and other nuisance factors is essential in all cases and critical near urban areas. Wetlands remove nutrients, toxics, and metals (e.g., mercury and selenium) which potentially accumulate and/or biomagnify in sediments and biotic tissues. Currently, there is a general lack of knowledge on how these substances and their accumulation affect wetlands and resident wildlife. In light of this information gap, a conservative approach should be used in evaluating the potential for adverse impacts to wildlife, particularly for substances that biomagnify. Monitoring and contingency plans will be necessary to avoid the creation of hazards. If it is determined that the runoff is

Management Plan Recommendations

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for Resolution 94-__:

Policy and Guidelines On the Use of Constructed Wetlands for Urban Runoff Control

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
SAN FRANCISCO BAY REGION

Final Draft
May 11, 1994

Policy On the Use of Constructed Wetlands for Urban Runoff Control

Management Plan Recommendations Resolution 94-102

I. Introduction

Under Resolution 94-102, provision 7, **proponents of a constructed wetland system for urban runoff treatment** must submit a management plan to the Regional Board. The management plan should provide detailed information on how compliance with provisions 1 through 6 of the Resolution will be achieved. This management plan, in addition to providing the necessary information to the Regional Board, will provide an "operations manual" for the proponent's use in managing the constructed wetland. The management plan should be prepared in consultation with the staff of the Regional Board, the State Department of Fish and Game, the State Department of Health, local vector control agencies, the U.S. Army Corps of Engineers, the U.S. Environmental Protection Agency, the Soil Conservation Service, and local storm water management programs. Any other relevant agencies or parties should be consulted as appropriate.

A draft management plan must be submitted with the initial proposal to construct an urban runoff treatment wetland. The draft management plan should be modified as needed when additional information becomes available through project and design planning, pilot work, or other investigations. A final management plan should be submitted prior to project construction. Any subsequent modifications to the management plan must be submitted to the Regional Board for approval.

In accordance with provision 7 of Resolution 94-102, the management plan must contain at a minimum:

A. A project plan,
B. An operations and maintenance plan,
C. A monitoring program, and
D. A summary of pilot work or other information collected.

Recommendations follow for the topics to be included and/or considered in the project plan, operations and maintenance plan, monitoring program, and pilot work sections of the management plan. These recommendations are not intended to be comprehensive. At the time of application, the Regional Board will determine if more information is required.

II. Recommendations

A. PROJECT PLAN

Provision 7.A of the Resolution specifies two subsets of requirements for the project plan. The first subset of required elements includes a description of 1) the site; 2) the physical facilities to be provided in the constructed wetland area; 3) the physical layout of the constructed wetland including all points of discharge to and from the wetland; 4) adjacent waters; 5) applicable pretreatment and source control measures; and 6) how the land is to be committed to this use for the project lifetime. **These are standard project plan elements and require no further explanation.**

The second subset of provision 7.A requirements contains elements unique to - or which should be considered carefully in light of - the construction of a wetland for urban runoff treatment. This subset requires that the management plan contain a description of 1) the project purpose; 2) the project objectives; 3) site selection; 4) site sampling; 5) planning and design elements; and 6) wetland design criteria. Recommendations for each of these elements follow:

1. Project Purpose

The purpose of the proposed constructed wetland project should be described. This section of the management plan should include a description of any federal, state, or local regulatory requirements satisfied by the construction of the urban runoff treatment wetland.

2. Project Objectives

Objectives established for the constructed wetland project should be defined early in the development of the management plan. This section should include a description of urban runoff treatment and storage objectives, and, if applicable, any community enhancement or wildlife habitat objectives. If the constructed wetland system will be connected with mitigation or other existing wetlands, objectives for the discharge from the constructed wetland should also be described.

3. Site Selection

The site selection process should include a careful examination of all existing site features and conditions. The applicant will also need to determine which of the required agencies and any other relevant parties to contact in considering a constructed wetland site. Recommendations for factors that should be considered in selecting a suitable site follow:

a. Substrate - Important properties include soil type, permeability, texture, salt and nutrient content, and pollutant concentration.

b. Hydrology/Geomorphology - Issues to consider include source and supply of water, location within watershed, ground water elevation and gradient, and existing surface water drainage patterns.

c. Vegetation - In choosing a site, the applicant should consider *in situ* vegetation sources including seed banks, and the desirable and undesirable vegetation that may colonize the wetland.

d. Wildlife - Considerations should include the species which presently inhabit or visit the site; particularly the presence of endangered species.

e. Wetlands - Delineation of any existing wetlands at the site should be considered for purposes of planning and design justification. Accurate delineations may be necessary to avoid conflicts with existing wetlands and demonstrate that the constructed wetland will be located on an upland portion of the site.

f. Landscape and Land Use - The location of the site within the surrounding landscape should be examined. Would the constructed wetland be compatible with local land uses and nearby wetlands? What is the potential for human or domestic animal disturbances?

4. Site Sampling and Analyses

Initial sampling and analyses of the site sediments, surface waters and/or ground water may be necessary to determine whether pollutants are already present at the site. The extent of sampling and type of analyses should be determined, in part, by the past uses of the site. Site-descriptive sampling such as vegetation type and soil type should also occur.

5. Planning and Design Elements

The following are examples of elements that should be considered in construction of an urban runoff treatment wetland:

a. Wetland Size - A large surface area to volume ratio and extended retention time are important for water quality treatment. Current design manuals recommend that the constructed wetland have a surface area equal to approximately 2% of the tributary watershed. Adequate acreage will be needed to prevent formation of unplanned ponds or system short circuiting in cases of large or high-velocity flows.

b. Hydrology/Geomorphology - A good understanding of hydrology and geomorphology is critical in achieving goals associated with treatment. The rate and flow capacity of the wetland will need to be designed to promote

treatment functions. Other factors to consider include drainage patterns, seasonal pulses, and percolation rates.

c. Physical Elements - Physical elements include bays, bank slope, bank height, channels, berms, tide gates and other water control structures; maintenance access; and flow paths. A forebay is an important element for collection of sediment and other debris. The forebay may require periodic clean-out and should be designed for convenient access.

d. Vegetation - The applicant will need to determine the wetland vegetation desired, how vegetation will be propagated, measures to control nuisance species, and implications of vegetation choices for surrounding wetlands and wildlife. Plants that store pollutants may require harvesting in order to avoid reintroduction of pollutants after annual die-backs. Adjacent wetlands may restrict the choice of plants in order to avoid the spread of nuisance or non-native species. Wetland plants chosen will differ if the applicant wishes to provide wildlife habitat or, instead, prefers to discourage wildlife use of the wetland.

e. Wildlife - Although wetlands constructed under this policy will have the primary purpose of urban runoff treatment, some habitat value is expected. The applicant should determine the species that are likely to colonize the wetland, and whether wildlife use will be encouraged or discouraged. This decision should be based, in part, on anticipated quality of the runoff. If runoff is expected to contain harmful amounts of metals or other toxics, wildlife use of the wetland must be discouraged. Should endangered species be present at the site, design modifications may be necessary. In these cases, the U.S. Fish and Wildlife Service must be contacted.

f. Vector Control - Vector control may include altering the wetland's hydrology, or use of biological or chemical control methods. These and other vector control considerations should be discussed with the local vector control agency.

g. Safety Measures - Safety measures such as gentle slopes, fences in dangerous areas, and a buffer zone around the constructed wetland will act as an offset from the surrounding community and reduce potential hazards. If the constructed wetland is to be connected with - or adjacent to - existing wetlands, a buffer zone may be necessary to protect the natural areas and wildlife from disturbances.

6. Wetland Design Criteria

In order to aid in interpreting the impact of future conditions on the functional capacity of the constructed wetland, it is recommended that all values determined

in the design and construction of the wetland be listed. It will be important for future operators and regulatory personnel to be aware of the estimations and assumptions that were made during the design process. Standard project design values that should be developed and listed in the project plan include the initial and design years, design population, urban runoff characteristics, and hydraulic loading rates. Design values unique to constructed wetlands - or which must be considered carefully in light of wetlands operations and treatment functions - include operational water depth, average and actual detention times, hydrocycle (showing all discharge and recharge pathways and volumes), and vegetation type, density and distribution.

B. OPERATIONS AND MAINTENANCE PLAN

Provision 7.B of the Resolution requires that the management plan include an operations and maintenance plan, contingency plans and a vector control program. An operations and maintenance schedule must be developed and the responsibility for it established based on agreements made during the management plan review process. The commitment to maintain and operate the constructed wetland may come from an authority other than the applicant. Potential sponsors of the constructed wetland system include municipalities, local flood control or water quality agencies, and, in cases of development, homeowner's associations. The operations plan should include a sequential listing of actions needed to ready the constructed wetland system and its manager for operation once construction is completed.

During initial years after construction, frequent maintenance will be necessary in order to correct miscalculations in planning and design, and to verify the level of water quality treatment in the wetland. Wetland vegetation in particular is difficult to establish, and may require re-planting. Thereafter, routine operation and maintenance should occur. Routine operation and maintenance activities should include frequent inspections to visually evaluate influent and effluent conditions to determine performance in removal of visual pollutants; water levels to determine storage capacity and retention time; and to determine operation of key design features such as inlet and outlet structures. Other maintenance activities include adjustments to flow patterns, mowing and harvesting, sediment clean-out, and upkeep of channels and other physical structures. Some examples of maintenance activities relevant to the operation of a constructed wetland follow:

1. Vegetation Planting and Harvesting

The plan for vegetation management should include indicators as to when planting would be necessary, the planting procedure to be followed, and criteria to determine whether a planting was successful. (Diversity of vegetation and success of planting efforts will depend on water depths and the presence of a top layer of organic soil.) In order to support diverse vegetation, the wetland should

be designed for a variety of water depths and a top layer of organic soil. If vegetation harvesting will occur, a plan should be developed to identify the factors determining its necessity and frequency, the harvesting procedures to be followed, and a plan for disposal of harvested material.

2. Channel and Bank Maintenance

The plan for channel and bank maintenance in the constructed wetland should include indicators as to when maintenance is necessary, the procedures to follow, and a plan for disposal of any dredged material. Maintenance costs for sediment removal may be minimized if there is available land area for on-site disposal.

3. Pump and Gate Maintenance

A routine maintenance program should be developed for all mechanical devices necessary to the operation of the constructed wetland treatment system. This program should ensure appropriate flooding and drying cycles necessary to the maintenance of constructed wetland treatment functions.

4. Vector Controls

A program for control of mosquito populations and other nuisance insects should be developed in conjunction with the local vector control agency and outlined in the management plan.

5. Contingency Plans

a. Objectives Not Achieved: Guidance should be developed for procedures to follow if the planned treatment functions of the constructed wetland are not realized.

b. Design Values Exceeded: The management plan should include measures for addressing temporary exceedences, as well as guidelines and options for addressing long-term or permanent exceedences. This includes cases where the constructed wetland's treatment and/or storage capacity is exceeded.

c. Nuisance Conditions: Guidance should be outlined in the management plan for procedures to determine nuisance conditions, their causes, and the remedial actions necessary.

d. Toxicity Determined: A contingency plan should be developed in conjunction with the monitoring program to determine appropriate remedial actions if toxicity is determined to be present in constructed wetland sediments or water.

C. MONITORING PROGRAM

1. Policy Monitoring Requirements

Provision 7.C of the Resolution requires that the management plan contain a monitoring program for vector control, water quality treatment, and any necessary habitat and wildlife evaluations. Provision 5 of the Resolution requires monitoring to demonstrate that pollutants and other substances transferred to the constructed wetland do not harm wildlife due to direct toxicity or bioaccumulation in the food chain. The wetland operator must also demonstrate that the constructed wetland does not create vector problems, nuisance, or promote avian botulism or other infectious diseases.

2. Additional Monitoring Elements

Examples of elements that should be monitored include the wetland sediment, water column, vegetation, and wildlife. Sediment and water column sampling will provide the applicant with information necessary to maintain the treatment functions of the constructed wetland. Vegetation monitoring may include chemical or physical sampling, and would serve to inform the applicant of habitat hazards as well as treatment functions. Monitoring of wildlife should include observations or inventories. Periodic monitoring of mosquito populations and other nuisance insects is also a component of the required monitoring program.

3. Monitoring Frequency

Frequency of monitoring will be determined by Regional Board staff and should be outlined in the management plan. Should the constructed wetland treatment system reach a reliable level of performance, the requirements for monitoring may be adjusted over time. Constructed wetlands that have a past history of compliance and are appropriately operated and maintained may not require monitoring as extensive as newly constructed or less reliable systems. Similarly, constructed wetlands that are not achieving water treatment objectives may require additional monitoring in order to determine the source of the problem. Adjustments in monitoring requirements will be made on a case-by-case basis and upon approval of the Executive Officer. However, in any case, a minimum of baseline water quality monitoring will be required in order to maintain the constructed wetland and assure adequate treatment.

4. Reporting

Regional Board staff should be consulted to determine reporting schedules, and these schedules should be outlined in the management plan. Reports should include updates on the status of the constructed wetland, recent monitoring results, and any operational or structural changes.

III. RESOURCES

A. Information Sources

1. Agencies

All agencies consulted in determining requirements and objectives for the project should be listed in the management plan. Names and phone numbers of contacts should be provided where possible.

2. Regulatory Requirements

Copies of orders, policies, or other regulations that apply to the project should be included in the management plan.

3. Publications

Publications or guidance materials used in the development of a management plan should be listed and available for reference.

B. References

Regional Board staff recommend the following sources for further information concerning urban runoff control and construction of treatment wetlands:

1. California Storm Water Best Management Practice Handbooks, Municipal Handbook. 1993. Storm Water Quality Task Force.

2. *Design of Stormwater Wetland Systems: Guidelines for Creating Diverse and Effective Stormwater Wetland Systems in the Mid-Atlantic Region.* 1992. Schueler, T. Metropolitan Washington Council of Governments. Washington D.C.

3. U.S. Environmental Protection Agency. 1993. *Created and Natural Wetlands for Controlling Nonpoint Source Pollution.* Office of Research and Development and Office of Wetlands, Oceans, and Watersheds, Washington D.C.